CLAIMS

1. A method of forming a cationic electrodeposition film, comprising immersing an article to be coated, composed of a galvanized steel sheet, into a bath tank filled with a cationic electrocoating liquid containing a base resin and forming an electrodeposition film on the surface of said galvanized steel sheet by current-carrying,

wherein an electric through hole is formed within said film to secure the conductivity of said film in order to wipe out a spark discharge phenomenon arising due to the presence of a hydrogen bubble produced through cohesion of hydrogen gas, with the passage of time, generated by said current-carrying at a gap of the film, which develops in depositing/forming the film by said current-carrying and increasing its thickness with the passage of time, on the surface of said galvanized steel sheet, and

thereby an increase in an electric resistance value ($k\Omega \cdot cm^2$) per unit weight (mg) of said film is inhibited.

2. The method of forming a cationic electrodeposition film according to Claim 1,

wherein a component composing said film comprises said base resin, said base resin is an amine-modified epoxy resin and said electric through hole is formed by locating an acid group (-COO-) in the vicinity of an end amino group of said amine-modified epoxy resin.

3. The method of forming a cationic electrodeposition film according to Claim 2,

wherein the acid group (-COO-) is a product of a reaction of an acid anhydride and an amino group.

4. The method of forming a cationic electrodeposition film according to Claim 1,

wherein said electric through hole is one formed by locating an acid group derived from a resin containing an acid group, which is poorly soluble in water.

5. The method of forming a cationic electrodeposition film according to Claim 1,

wherein said electric through hole is one formed by locating an acid group derived from an amphoteric ion group-containing resin.

6. A method of forming a cationic electrodeposition film, comprising immersing an article to be coated, composed of a galvanized steel sheet, into a bath tank filled with a cationic electrocoating liquid containing a base resin and forming an electrodeposition film on the surface of said galvanized steel sheet by current-carrying,

wherein a spark discharge phenomenon in a hydrogen bubble on the surface of said galvanized steel sheet is inhibited by controlling an increase in an electric resistance value ($k\Omega \cdot cm^2$) per unit weight (mg) of the film deposited/formed by said current-carrying.

7. A method of forming a cationic electrodeposition film, comprising immersing an article to be coated, composed of a galvanized steel sheet, into a bath tank filled with a cationic electrocoating liquid containing a base resin and forming an electrodeposition film on the surface of said galvanized steel sheet by current-carrying,

wherein an electric resistance value ($k\Omega \cdot cm^2$) per unit weight (mg) of the film deposited/formed by said current-carrying is 1.0 or less within 4 seconds after said current-carrying is initiated and 2.0 or more after a lapse of 10 seconds after said current-carrying is initiated.

8. A method of forming a cationic electrodeposition film,

comprising immersing an article to be coated, composed of a galvanized steel sheet, into a bath tank filled with a cationic electrocoating liquid containing a base resin and forming an electrodeposition film on the surface of said galvanized steel sheet by current-carrying,

wherein an increase in an electric resistance value ($k\Omega \cdot cm^2$) per unit weight (mg) of said film is suppressed for 4 seconds from the initiation of current-carrying in order to wipe out a spark discharge phenomenon arising due to the presence of a hydrogen bubble produced through cohesion of hydrogen gas, with the passage of time, generated by said current-carrying at a gap of the film, which develops in depositing/forming the film by said current-carrying and increasing its thickness with the passage of time, on the surface of said galvanized steel sheet.

9. The method of forming a cationic electrodeposition film according to Claim 7 or 8,

wherein said current-carrying condition is a manner in which voltage is elevated at a constant rate in a condition of selecting 5 seconds as a duration until reaching a predetermined applied voltage and

in this condition a temperature of a bath liquid is 20 to 40°C during coating,

a concentration of non-volatile matter of a bath liquid is 15 to 25 % by weight during coating,

an area ratio between an article to be coated and an electrode is 1:1 to 2:1 and a distance between electrodes is 15 cm.

10. A cationic electrocoating composition containing a base resin

which can secure the conductivity of a film by forming an electric through hole within a film deposited/formed by current-carrying during cationic electrodeposition process,

and inhibit an increase in an electric resistance value ($k\Omega \cdot cm^2$) per unit weight (mg) of said film.

11. The cationic electrocoating composition according to Claim 10,

wherein a component composing said film comprises said base resin, said base resin is an amine-modified epoxy resin and said electric through hole is formed by locating an acid group (-COO-) in the vicinity of an end amino group of said amine-modified epoxy resin.

12. The cationic electrocoating composition according to Claim 11,

wherein the acid group (-COO-) is a product of a reaction of an acid anhydride and an amino group.

13. The cationic electrocoating composition according to Claim 10,

wherein said electric through hole is one formed by locating an acid group derived from a resin containing an acid group, which is poorly soluble in water.

14. The cationic electrocoating composition according to Claim 10,

wherein said electric through hole is one formed by locating an acid group derived from an amphoteric ion group-containing resin.

15. A cationic electrocoating composition

which can control an increase in an electric resistance value ($k\Omega \cdot cm^2$) per unit weight (mg) of a film deposited/formed by current-carrying during cationic electrodeposition process.

16. A cationic electrocoating composition

which can render an electric resistance value ($k\Omega \cdot cm^2$)

per unit weight (mg) of a film deposited/formed by current-carrying during cationic electrodeposition process 1.0 or less within 4 seconds after the current-carrying is initiated and 2.0 or more after a lapse of 10 seconds after the current-carrying is initiated.

17. A cationic electrocoating composition

which can suppress an increase in an electric resistance value ($k\Omega \cdot cm^2$) per unit weight (mg) of a film for 4 seconds from the initiation of current-carrying in order to wipe out a spark discharge phenomenon arising due to the presence of a hydrogen bubble produced through cohesion of hydrogen gas, with the passage of time, generated by said current-carrying at a gap of the film, which develops in depositing/forming the film by current-carrying during cationic electrodeposition process and increasing its thickness with the passage of time.

18. The cationic electrocoating composition according to Claim 16 or 17,

wherein said current-carrying condition is a manner in which voltage is elevated at a constant rate in a condition of selecting 5 seconds as a duration until reaching a predetermined applied voltage and

in this condition a temperature of a bath liquid is 20 to 40°C during coating,

a concentration of non-volatile matter of a bath liquid is 15 to 25 % by weight during coating,

an area ratio between an article to be coated and an electrode is 1:1 to 2:1 and a distance between electrodes is 15 cm.